RECEIVED
CENTRAL FAX CENTER
MAY 1 2 2008

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. (Currently Amended) A method of performing a total arthroplasty of a ball and socket joint of a patient using a surgical navigation system wherein the joint has a socket and a limb having a ball shaped head at a proximal end of the limb near the socket comprising the steps of:

constructing a three dimensional model of the joint intra-operatively using an analysis of anatomical biomechanical axes of the joint and the surgical navigation system to mark the patient's anatomical landmarks ~~based on the marking of the patient's anatomical landmarks and the analysis of anatomical biomechanical axes of the joint~~;

performing a virtual trial based on the three dimensional model with implant information available in a database, wherein the virtual trial includes the steps of, virtually locating a correct angle and position for resection of the limb, virtually preparing the joint to receive an implant component, estimating an effect of soft tissue on stability of the joint based on the biomechanical axes and gaps identified in the virtual trial, and virtually assessing a proposed range of motion of the joint;

preparing the limb to receive a stem using the three dimensional model after completing the virtual trial;

~~wherein the three dimensional model is sufficient for performing a virtual trial with implant information available in a database and virtually preparing the joint to receive an implant component;~~

~~virtually assessing a proposed range of motion of the joint prior to inserting the stem in the limb;~~

placing the stem in the limb after preparing the limb; and

verifying the proposed range of motion of the joint with a selected implant after placing the stem in the limb.

2. (Original) The method of claim 1 wherein the ball and socket joint is a hip and wherein the method includes the additional steps of:

preparing the socket to receive a cup using the three dimensional model; and

placing the cup in the socket.

3. (Original) The method of claim 1 wherein the ball and socket joint is a shoulder.

4. (Previously presented) The method of claim 1 wherein the step of constructing the three dimensional model is based on non-invasively acquired landmarks.

5. (Previously presented) The method of claim 1 wherein the step of constructing the three dimensional model is based on invasively acquired landmarks.

6. (Original) The method of claim 1 wherein the three dimensional model is based in part on a neutral positioning of the limb.

7. (Original) The method of claim 1 wherein method includes the additional step of determining the stability of the joint.

8. (Original) The method of claim 1 wherein method includes the additional step of verifying the three dimensional model.

9. (Original) The method of claim 1 wherein the preparing of the limb is conducted by aligning a resection guide relative to a proximal shaft axis, a sagittal plane, and coronal plane as determined by the three dimensional model.

10. (Original) The method of claim 9 wherein the aligning of the resection guide is also relative to dimensions of a proposed implant and based on pre-surgically determined changes in geometry of the joint.

11. (Original) The method of claim 2 wherein the socket is an acetabulum and wherein the preparing of the socket is conducted by reaming of the acetabulum to a predetermined orientation guided by the surgical navigation system relative to the three dimensional model.

12. (Original) The method of claim 2 wherein the socket is an acetabulum and wherein the preparing of the socket is reaming of the acetabulum to a depth guided by the surgical navigation system relative to the three dimensional model.

13. (Original) The method of claim 12 wherein the depth relates to a medial wall of the acetabulum.

14. (Original) The method of claim 2 wherein the limb is a femur and wherein the preparing of the limb is conducted by broaching the femur to a predetermined depth guided by the surgical navigation system relative to the three dimensional model.

15. (Original) The method of claim 2 wherein the limb is a femur and wherein the preparing of the limb is conducted by broaching the femur to a predetermined orientation along a proximal shaft axis, a sagittal plane, and a coronal plane guided by the surgical navigation system relative to the three dimensional model.

16. (Original) The method of claim 2 wherein the inserting of the cup is conducted by impacting the cup to a depth guided by the surgical navigation system relative to the three dimensional model.

17. (Original) The method of claim 2 wherein the inserting of the cup is conducted by impacting the acetabular cup to an orientation guided by the surgical navigation system using the three dimensional model.

18. (Original) The method of claim 2 wherein the socket is an acetabulum and wherein the inserting of the cup is conducted by impacting the cup to a depth that relates to a previously recorded final depth of the prepared acetabulum.

19. (Original) The method of claim 2 wherein the socket is an acetabulum and wherein the inserting of the cup is conducted by impacting the cup to an orientation guided by the surgical navigation system using the three dimensional model.

20. (Original) The method of claim 18 wherein the inserting of the cup is conducted by impacting the cup to a depth that relates to a previously recorded final depth of the prepared acetabulum.

21. (Original) The method of claim 1 wherein the inserting of the stem is conducted by impacting the stem to a depth guided by the surgical navigation system using the three dimensional model.

22. (Original) The method of claim 1 wherein the inserting of the stem is conducted by impacting the stem to an orientation along a proximal shaft axis and a sagittal plane and a coronal plane guided by the surgical navigation system using the three dimensional model.

23. (Previously presented) The method of claim 2 wherein method includes the additional step of determining the stability of the joint and the joint stability is determined based on the three dimensional model and on a center of the cup and the stem.

24. (Original) The method of claim 2 wherein the range of motion is determined based on the three dimensional model and a center of the cup and the stem.

25. (Original) The method of claim 1 including the additional step of displaying a result of implant geometry changes on range of motion and joint stability.

26. (Original) The method of claim 25 wherein the results of the implant geometry changes on range of motion and stability are determined based on the three dimensional model and a center of the cup and the stem.

27. (Canceled)

28. (Currently Amended) A method of performing a total arthroplasty of a ball and socket joint of a patient using a surgical navigation system wherein the joint has a socket and a limb having a ball shaped head at a proximal end of the limb near the socket comprising the steps of:

constructing a three dimensional model of the joint intra-operatively using an analysis of anatomical biomechanical axes of the joint and the surgical navigation system to mark the patient's anatomical landmarks~~, based on the marking of the patient's anatomical landmarks and the analysis of the anatomical biomechanical axes of the joint~~;

performing a virtual trial of the joint and virtually preparing the joint to receive an implant component that provides optimum post surgery characteristics using the three dimensional model and implant component information stored in a database, wherein the virtual trial includes assessing length of the limb and range of motion of the joint with a proposed implant component in place before significant preparation of the limb has been done and estimating an effect of soft tissue on stability of the joint based on the biomechanical axes and any identified gaps;

preparing the limb to receive a stem using the three dimensional model;

placing the stem in the limb; and

determining the stability of the joint.

29. (Original) The method of claim 28 wherein the ball and socket joint is a hip and wherein the method includes the additional steps of:

preparing the socket to receive a cup using the three dimensional model; and placing the cup in the socket.

30. (Original) The method of claim 28 wherein the ball and socket joint is a shoulder.

31. (Previously presented) The method of claim 28 wherein the step of constructing the three dimensional model is based on non-invasively acquired landmarks.

32. (Previously presented) The method of claim 28 wherein the step of constructing the three dimensional model is based on invasively acquired landmarks.

33. (Original) The method of claim 28 wherein the three dimensional model is based in part on a neutral positioning of the limb.

34. (Previously presented) The method of claim 28 wherein method includes the additional step of determining the post surgery range of motion of the joint.

35. (Original) The method of claim 28 wherein method includes the additional step of verifying the three dimensional model.

36. (Original) The method of claim 28 wherein the preparing of the limb is conducted by aligning a resection guide relative to a proximal shaft axis and a sagittal plane and coronal plane as determined by the three dimensional model.

37. (Original) The method of claim 36 wherein the aligning of the resection guide is also relative to dimensions of a proposed implant and based on pre-surgically determined changes in geometry of the joint.

38. (Original) The method of claim 29 wherein the socket is an acetabulum and wherein the preparing of the socket is conducted by reaming of the acetabulum to a predetermined orientation guided by the surgical navigation system relative to the three dimensional model.

39. (Original) The method of claim 29 wherein the socket is an acetabulum and wherein the preparing of the socket is reaming of the acetabulum to a depth guided by the surgical navigation system relative to the three dimensional model.

40. (Original) The method of claim 39 wherein the depth relates to a medial wall of the acetabulum.

41. (Original) The method of claim 29 wherein the limb is a femur and wherein the preparing of the limb is conducted by broaching the femur to a predetermined depth guided by the surgical navigation system relative to the three dimensional model.

42. (Original) The method of claim 29 wherein the limb is a femur and wherein the preparing of the limb is conducted by broaching the femur to a predetermined orientation along a proximal shaft axis, a sagittal plane, and a coronal plane guided by the surgical navigation system relative to the three dimensional model.

43. (Original) The method of claim 29 wherein the inserting of the cup is conducted by impacting the cup to a depth guided by the surgical navigation system relative to the three dimensional model.

44. (Previously presented) The method of claim 29 wherein the inserting of the cup is conducted by impacting the acetabular cup to an orientation guided by the surgical navigation system using the three dimensional model.

45. (Original) The method of claim 29 wherein the socket is an acetabulum and wherein the inserting of the cup is conducted by impacting the cup to a depth that relates to a previously recorded final depth of the prepared acetabulum.

46. (Original) The method of claim 29 wherein the socket is an acetabulum and wherein the inserting of the cup is conducted by impacting the cup to an orientation guided by the surgical navigation system using the three dimensional model.

47. (Original) The method of claim 45 wherein the inserting of the cup is conducted by impacting the cup to a depth that relates to a previously recorded final depth of the prepared acetabulum.

48. (Original) The method of claim 28 wherein the inserting of the stem is conducted by impacting the stem to a depth guided by the surgical navigation system using the three dimensional model.

49. (Original) The method of claim 28 wherein the inserting of the stem is conducted by impacting the stem to an orientation along a proximal shaft axis, a sagittal

plane, and a coronal plane guided by the surgical navigation system using the three dimensional model.

50. (Original) The method of claim 29 wherein method includes the additional step of determining the range of motion of the joint and the range of motion is determined based on the three dimensional model and on a center of the cup and the stem.

51. (Original) The method of claim 28 including the additional step of displaying a result of implant geometry changes on joint stability.

52. (Original) The method of claim 51 wherein the results of the implant geometry changes on stability are determined based on the three dimensional model and a center of the cup and the stem.

53. (Previously Presented) The method of claim 28 including the additional step of performing a virtual trial using the three dimensional model of the joint and using a database of joint implant components to choose implant components and virtually preparing the joint to receive the implant components.

54-88 (Canceled)

89. (Currently Amended) A method of performing a total arthroplasty of a ball and socket joint of a patient using a surgical navigation system wherein the joint has a socket and a limb having a ball shaped head at a proximal end of the limb near the socket comprising the steps of:

constructing a three dimensional model of the joint intra-operatively using an analysis of anatomical biomechanical axes of the joint and the surgical navigation system to mark the patient's anatomical landmarks ~~based on the marking of the patient's anatomical landmarks and the analysis of anatomical biomechanical axes of the joint~~;

~~providing~~ <u>conducting</u> a virtual trial of the joint using the three dimensional model of the joint and data relating to implant components chosen from a database of joint implant components, wherein the three dimensional model enables a surgeon to virtually assess

offset, leg length and a range of motion of the joint during the virtual trial with a virtual proposed implant prior to commencing a surgical procedure, and wherein the virtual trial includes estimating an effect of soft tissue on stability of the joint based on the biomechanical axes and any identified gaps;

preparing a limb to receive a stem implant using the three dimensional model; and

placing the stem implant within the prepared limb;

wherein the step of providing the virtual trial occurs before placing the stem implant within the prepared limb.

90. (Original) The method of claim 89 wherein the ball and socket joint is a hip and wherein the method includes the additional steps of:

preparing the socket to receive a cup using the three dimensional model; and

placing the cup in the socket.

91. (Original) The method of claim 89 wherein the ball and socket joint is a shoulder.

92. (Original) The method of claim 89 wherein the three dimensional model is constructed based on non-invasively acquired landmarks.

93. (Original) The method of claim 89 wherein the three dimensional model is constructed based on invasively acquired landmarks.

94. (Original) The method of claim 89 wherein the three dimensional model is based in part on a neutral positioning of the limb.

95. (Original) The method of claim 89 wherein method includes the additional step of determining the stability of the joint.

96. (Original) The method of claim 89 wherein method includes the additional step of verifying the three dimensional model.

97. (Original) The method of claim 89 wherein the three dimensional model of the joint is constructed intra-operatively using the surgical navigation system based on landmarks on a patient.

98. (Original) The method of claim 89 wherein the three dimensional model of the joint is constructed based on pre-operative scan data.

99. (Canceled)

100. (Canceled)

101. (Original) The method of claim 89 wherein the virtual trial is conducted after to the preparation of the joint.

102. (Canceled)

103. (Original) The method of claim 89 including the additional step of displaying a result of implant geometry changes on joint stability.

104. (Original) The method of claim 103 wherein the range of motion is determined based on the three dimensional model and a center of the stem.

105. (Original) The method of claim 89 including the additional step of displaying a result of implant geometry changes on joint range of motion.

106. (Original) The method of claim 105 wherein the results of implant geometry changes on range of motion are determined based on the three dimensional model and a center of the stem.

107-122. (Canceled)

123. (New) A method of performing a total arthroplasty of a ball and socket joint of a patient using a surgical navigation system wherein the joint has a socket defined by a bone and a limb having a ball shaped head at a proximal end of the limb near the socket comprising the steps of:

initializing a surgical navigation system with patient information, pre-surgical planning information including information relating to a desired change of limb length, and desired change in joint offset;

constructing a three-dimensional model of the joint intra-operatively using an analysis of anatomical landmarks obtained from an intra-operative anatomical survey of the patient using the surgical navigation system, wherein the anatomical landmarks are used to calculate at least a first plane and a second plane, and wherein the first plane is defined by at least three points associated with the bone and the second plane is defined by at least two points associated with the limb, and identifying a relationship between the first plane and the second plane;

accessing a database containing data for a wide range of implant components, including data for selected implant components;

virtually simulating preparation of the joint with information regarding proposed implant components from the database and the three-dimensional model of the joint in a proposed position;

virtually assessing joint offset, limb length, range of motion of the joint, and gaps in structures with the proposed implant components in the proposed position before significant preparation of bone has occurred; and

preparing the joint and placing the proposed implant components in the proposed position after virtually simulating preparation of the joint.

124. (New) The method of claim 123, wherein the step of constructing a three-dimensional model of the joint includes the step of identifying an anatomical biomechanical axis of the limb, and

wherein the step of virtually assessing joint offset further comprises the step of estimating effects of soft tissue on stability of the joint based on the biomechanical axis and the gaps.

125. (New) The method of claim 123, wherein the joint comprises a hip joint and the bone is a pelvis, and wherein the step of constructing the three-dimensional model includes the steps of:

recording pelvic landmarks of the patient;

calculating a frontal plane of the pelvis based on the pelvic landmarks;

calculating a pelvic coordinate system based on the frontal plane of the pelvis;

recording femoral landmarks of a femur associated with the hip joint;

calculating a femoral sagital plane based on the femoral landmarks;

calculating a femoral coordinate system based on the femoral sagital plane;

calculating a center of the hip joint; and

calculating a transformation between the pelvic coordinate system and the femoral coordinate system.

126. (New) The method of claim 125, wherein the step of recording the pelvic landmarks includes the steps of:

digitizing a left ASIS of the patient; and

digitizing a right ASIS of the patient.

127. (New) The method of claim 126, wherein the step of recording the pelvic landmarks further includes the steps of:

digitizing a left pubic tubercle of the patient; and

digitizing a right pubic tubercle of the patient.

128. (New) The method of claim 126, wherein the step of recording the pelvic landmarks further includes the steps of:

digitizing a suspensory ligament of the patient.

129. (New) The method of claim 126, wherein the pelvic coordinate system comprises an x-axis on the pelvic frontal plane, a y-axis normal to the pelvic frontal plane, and a z-axis normal to the x-axis and the y-axis.

130. (New) The method of claim 125, wherein the step of recording the femoral landmarks comprises the steps of:

digitizing a piriformis fossa of the femur to be treated;

digitizing a popliteal fossa of the femur to be treated;

flexing a knee joint associated with the femur to be treated to form a femoral sagital plane; and

digitizing an achilles midpoint associated with the knee joint.

131. (New) The method of claim 130, wheren the femoral coordinate system comprises an x-axis normal to the sagital plane, a z-axis cooresponding to an anatomical axis defined by the piriformis fossa and the popliteal fossa, and a y-axis perpendicular to the x-axis and the z-axis.

132. (New) The method of claim 125, wherein the step of calculating a center of the hip joint includes the steps of:

attaching a tracking device to a distal end of the femur;

rotating the femur within view of the surgical navigation system;

digitizing a series of locations of the femur while rotating the femur; and

matching a center of a sphere to the series of locations.

133. (New) The method of claim 125, wherein the step of calculating a center of the hip joint includes the steps of:

dislocating the femur from a corresponding acetabulum of the pelvis; and

digitizing an articular surface of the acetabulum.

134. (New) The method of claim 133, further comprising the step of digitizing a shape of a fovea of the femur.

135. (New) The method of claim 123, wherein the joint comprises a shoulder joint and the bone is a scapula.

136. (New) The method of claim 123, wherein the three-dimensional model is not compared to a scan.

137. (New) A method of performing a total arthroplasty of a hip joint of a patient using a surgical navigation system, wherein the hip joint comprises a pelvis having an acetabular socket and a femur having a ball shaped fovea corresponding to the acetabular socket, wherein the method comprises the steps of:

constructing a three-dimensional model of the hip joint intra-operatively using the surgical navigation system based on the patient's anatomical landmarks, wherein the step of constructing the three dimensional model includes the steps of determining a frontal pelvic plane of the pelvis, determining a pelvic coordinate system from the pelvic plane, determining a hip center, determining an anatomical axis and a femoral sagital plane of the femur, and determining a femoral coordinate system from the anatomical axis and the femoral sagital plane;

preparing the femur to receive a stem using the three dimensional model;

placing the stem in the femur after preparing the femur; and

determining a range of motion of the hip joint.

138. (New) The method of claim 137, further comprising the step of virtually simulating preparation of the joint with information regarding proposed implant components in a proposed position and the three-dimensional model of the joint;

139. (New) The method of claim 138, further comprising the step of virtually assessing joint offset, limb length, range of motion of the joint, and gaps in structures with the proposed implant components in the proposed position and estimating effects of soft tissue on stability of the joint based on the anatomical axis and the gaps before significant preparation of bone has occurred using the three-dimensional model and information regarding proposed implant components.

140. (New) The method of claim 1, wherein the joint is a hip joint with the socket defined by a pelvis and a femur articulably corresponding to the socket, wherein the step of constructing the three dimensional model further includes the steps of:

determining a frontal pelvic plane of the pelvis;

determining a pelvic coordinate system from the pelvic plane;

determining a hip center;

determining an anatomical axis and a femoral sagital plane of the femur; and

determining a femoral coordinate system from the anatomical axis of the femur and the femoral sagital plane.

141. (New) The method of claim 140, wherein the step of determining the frontal pelvic plane comprises the steps of:

recording a location of a left ASIS of the pelvis; and

recording a location of a right ASIS of the pelvis.

142. (New) The method of claim 141, wherein the step of determining the frontal pelvic plane further includes the steps of:

recording a location of a left pubic tubercle of the pelvis; and

recording a location of a right pubic tubercle of the pelvis.

143. (New) The method of claim 141, wherein the step of determining the frontal pelvic plane further includes the steps of:

recording a location of a suspensory ligament of the patient.

144. (New) The method of claim 141, wherein the step of determining the femoral coordinate system comprises the steps of:

recording a location of a piriformis fossa of the femur;

recording a location of a popliteal fossa of the femur;

flexing a knee joint associated with the femur to form a femoral sagital plane;

recording a location of an achilles midpoint associated with the femoral sagital plane; and

calculating the anatomical axis of the femur and the femoral sagital plane from the recorded locations of the piriformis fossa, the popliteal fossa, and the achilles midpoint.

145. (New) The method of claim 144, wherein the step of determining the hip center includes the steps of:

rotating the femur within view of the surgical navigation system;

recording a series of locations of the femur while rotating the femur; and

matching a center of a sphere to the series of locations.

146. (New) The method of claim 145, wherein the step of determining the hip center further includes the steps of:

dislocating the femur from a corresponding acetabulum of the pelvis; and

digitizing an articular surface of the acetabulum.

147. (New) The method of claim 146, further comprising the step of digitizing a shape of a fovea of the femur.

148. (New) The method of claim 1, wherein the three dimensional model is not compared to a scan.